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RELATIONSHIP OF LOG PRODUCTION IN OREGON AND WASHINGTON TO ECONOMIC CONDITIONS

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ABSTRACT

Increasing demand for timber has put upward pressure on log production levels in Oregon and Washington. Fluctuations in log production result primarily from changes in national demand for wood products. The log production cycle with respect to business conditions has become countercyclical since World War II. During the 1949-69 period, annual changes in housing starts, lagged 1 year, were significantly related to changes in total timber harvest on all ownerships and to changes in National Forest stumpage prices for all species. Annual stumpage price changes were significantly related to annual changes in log production.

KEYWORDS: Forestry business economics, timber, housing, forest appraisal.

INTRODUCTION

Log production can be viewed as a comprehensive index of economic activity in the timber economy. It is a measure of the total forest output required to meet demands for all wood products including lumber, plywood, and fiber products. The purpose of this paper is to deal with the relationship of business conditions to fluctuations in log production in Oregon and Washington. Understanding the relationship of economic factors to Pacific Northwest forest output should assist in the timing of timber harvests as requirements for wood change in the marketplace.

In this paper, historical changes in business conditions and log production fluctuation patterns are reviewed. Analyses of some economic factors related to log production are presented and economic relationships are considered.

LOG PRODUCTION FLUCTUATIONS

Long-term log production trends have been generally upward in the Pacific Northwest. Figure 1 shows this upward trend between 1879 and 1970. A detailed analysis of log production by geographic area and by owner group is presented in the Resource Bulletin titled "Log Production in Washington and Oregon--an Historical Perspective" (Wall 1972). The upward trend in log production is the result of rising demands for industrial roundwood products in the Nation and the migration of the timber industry to the Pacific Northwest to fulfill that demand. A second kind of movement within this upward trend shown on the graph is the short-term fluctuation.

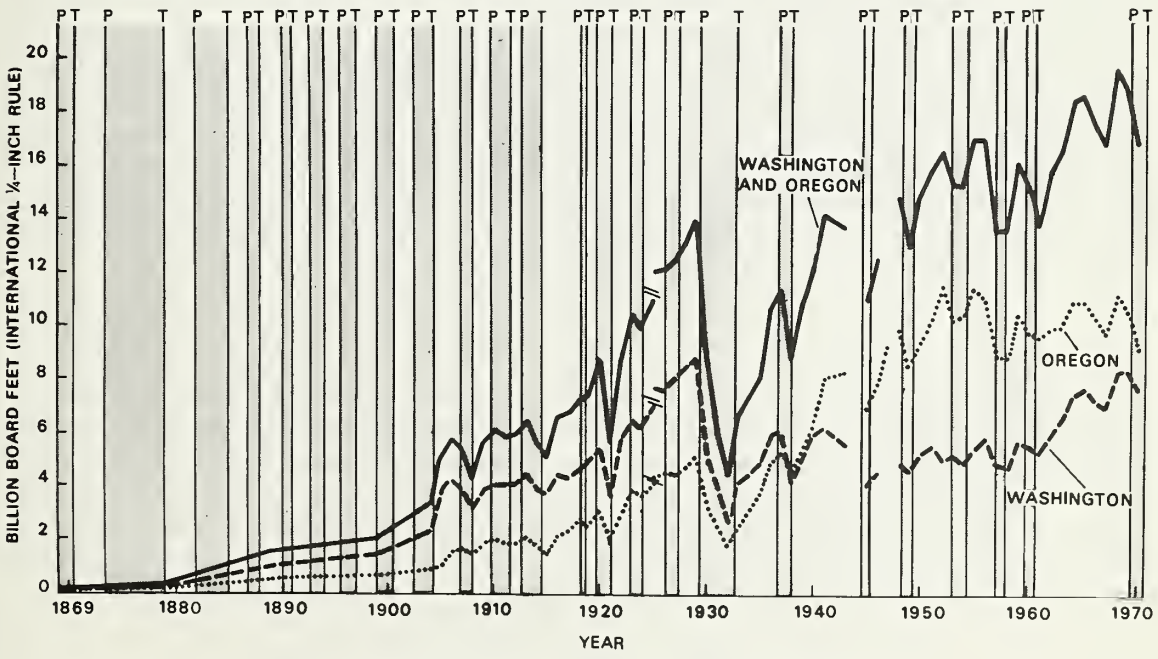

Figure 1.—Log production in Oregon and Washington, 1869-1970.

These production fluctuations seem to have some relationship to national business conditions as depicted by the shaded areas of figure 1. In figures 1 and 2, these shaded areas are contraction periods in the business economy as defined by the National Bureau of Economic Research. The unshaded areas are national economic expansion periods. Figure 1 shows that until World War II, contraction periods occurred every few years in our economy; these periods were characterized by such descriptive names as the Depression of 1884, the Panic of 1893, the Silver Campaign Depression of 1896-97, the Rich Man's Panic (around 1904), the Panic of 1907, the Primary Postwar Depression of the early 1920's, and the Secondary Postwar Depression or the Great Depression of the 1930's. Since the mid-1940's, we have had general prosperity with six business recessions, the last of which began in late 1969. The year 1966 was a near-recession during the Nation's longest expansion period, February 1961 through November 1969.

Log Production Cyclical Characteristics Changed After World War II

Fluctuations in log production in Oregon and Washington with respect to business cycles differ before and after World War II. With the exception of the 1904-5 expansion period, the so-called Corporate Prosperity Period, log production in the early years tended to peak with the general economy. Since World War II, Oregon and Washington log production has tended to peak before the national business economy. The difference in cyclical characteristics before and after World War II could be due to changes in a number of factors. The most important changes probably lie in factors which affect timber demand. In the Pacific Northwest, as elsewhere, the demand for logs is a derived demand. In theory, timber sellers' behavior and timber-cutting patterns should be affected by changes in the demand for wood products.

Dr. Walter Mead (1961) observed a possible cause of the change in the postwar years when significant changes occurred in the cyclical characteristics of the lumber industry. Mead examined the Douglas-fir region's lumber production and lumber prices as related to national business cycles. He noted that "the pro-cyclical behavior up to World War II has been replaced by counter-cyclical characteristics" and that the degree of variation in lumber production has become much less severe. His study showed that, during the period examined, the shift of lumber prices was similar to that of lumber production.

Mead examined the interwar and postwar cycles in residential construction to see if similar shifts, such as found in lumber production, had developed. He said the principal element in the demand for lumber was construction, accounting for 75 percent of all lumber used, with residential construction alone accounting for 40 percent. He concluded that residential construction awards had become countercyclical after World War II, and he presumed a causal relationship between the new residential construction awards and the new lumber production and price patterns.

Mead noted that through the 1920's and well into the 1930's the influence of the Government on construction was minimal; but after World War II, it became important. He noted that conventionally financed construction was found to be a stable sector with a behavior pattern as often procyclical as countercyclical. He examined the Federal programs to determine if they had produced countercyclical results and concluded that the countercyclical results were due, not to the exercise of judgment in altering mortgage terms, but to interest rate conditions:

> During the later expansion phase immediately prior to a peak in economic activity when market rates of interest are normally high, the spread between bond yields and contract FHA-VA interest rates on mortgages becomes relatively unattractive to investors, and mortgage money tends to avoid the federally insured market. Borrowers are left with high downpayment conventional alternatives. As a result, new mortgages issued during tight money periods decline. Conversely during a recession, market rates of interest decline as the Federal Reserve System acts to produce monetary ease. FHA and VA mortgage paper becomes relatively attractive. Thus, Federal Reserve monetary policy and interest rate factors make an important contribution to the observed post-war countercyclical pattern of residential construction and, therefore, to the new patterns of cyclical behavior in lumber production and price.

To some extent, log production fluctuations probably can be attributed to the factors examined by Mead. Figure 2 shows log production and selected business indicators including housing starts, personal disposable income, bond yields, FHA new home mortgage yields, and National Forest Region 6 stumpage prices for all species (U.S. Congress, Joint Economic Committee 1971, Darr 1970). Unfortunately, as log production data are on an annual basis, direct analysis with monthly data is impossible. The figure shows that annual log production, housing starts, and stumpage prices have similar and roughly coincidental cycles. FHA mortgage yields for new homes tend to reflect the easing of money in the early periods of economic expansion and the high price of money in the later periods; these mortgage yield patterns tend to run somewhat counter to housing starts, stumpage prices, and log production.

Analysis of Log Production Changes

A statistical analysis determined relationships among changes in log production and changes in FHA yields, housing starts, and Region 6 National Forest stumpage prices. It was hypothesized that log production changes on an annual basis respond inversely to changes in the price of mortgage money (FHA yields) and directly with actual new housing starts.

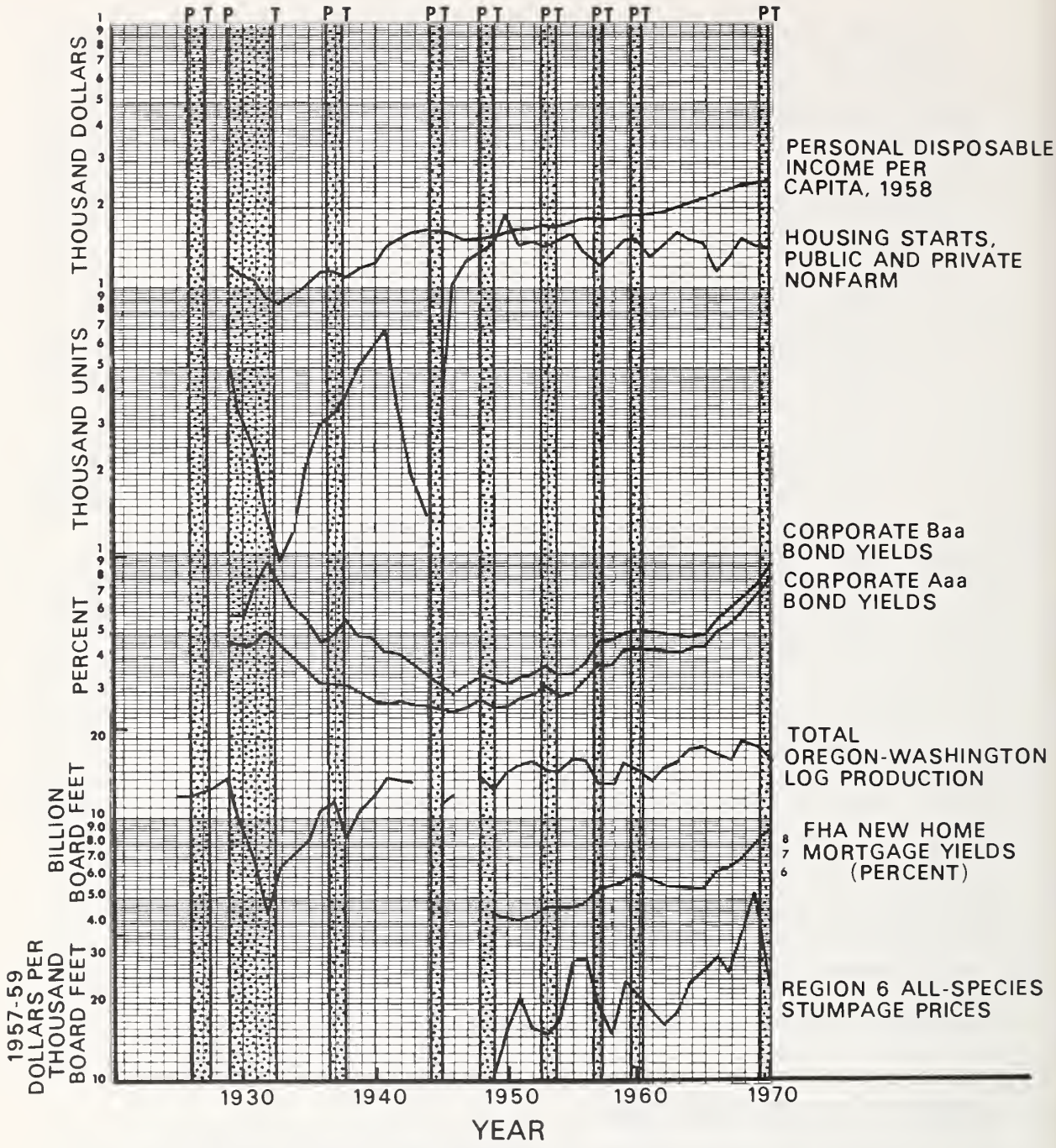

Figure 2.—Total log production and selected business indicators.

Figure 3 shows the annual change in log production in Oregon and Washington related to the annual change in FHA mortgage yields in the United States. The plotted points, as expected, indicate the tendency for large increases in FHA yields to be associated with lagged declines in log production and declines in FHA yields to be associated with lagged increases in log production. However, small changes in yields were associated with both increases and decreases in log production. The relationship of lagged log production to FHA yields was not significant at the 5-percent level, but the margin of rejection was very small (i.e., it would have been significant at approximately the 6-percent level with an R^2 of 0.20).[1/] This means that very little of the annual change in log production can be explained by an annual change in yields on FHA mortgages.

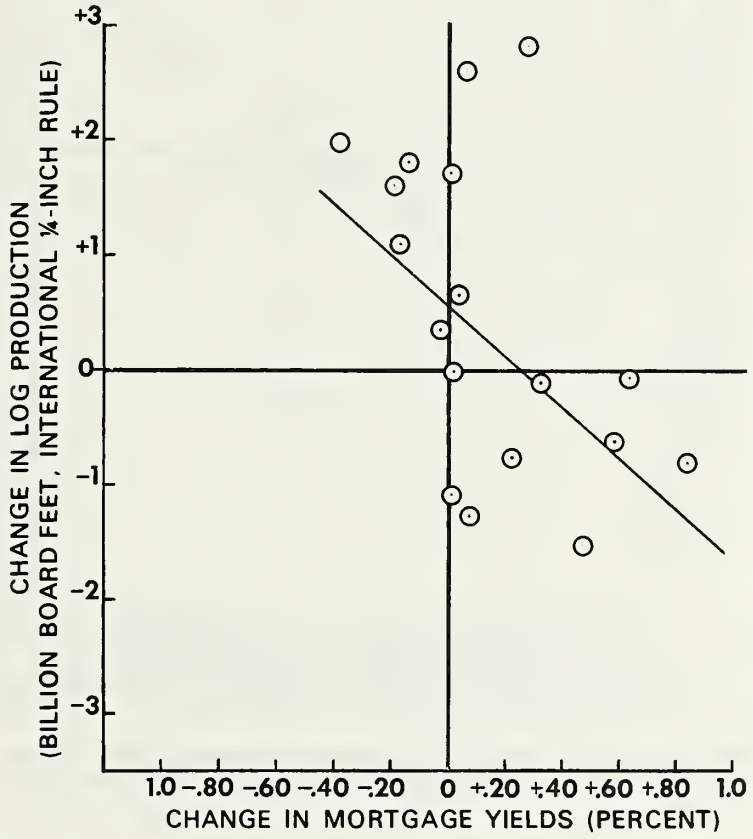

Figure 3.—Change in Washington and Oregon log production related to the change in FHA mortgage yields, lagged 1 year, for the 1949-69 period.

[1] R^2 is the coefficient of determination which is a measure of how well the regression line fits the sample data. R^2 is the proportion of the variation in the dependent variable which is associated with the independent variable.

Next, the relationship between changes in log production and changes in housing starts, lagged 1 year, was tested (fig. 4). This relationship is significant at the 5-percent level with an R^2 of 0.24. The curve form is linear. The graph and data indicate that annual changes in housing starts by themselves do not explain very much of the variance in annual log production and thus would not make a good predictor of log production fluctuations.

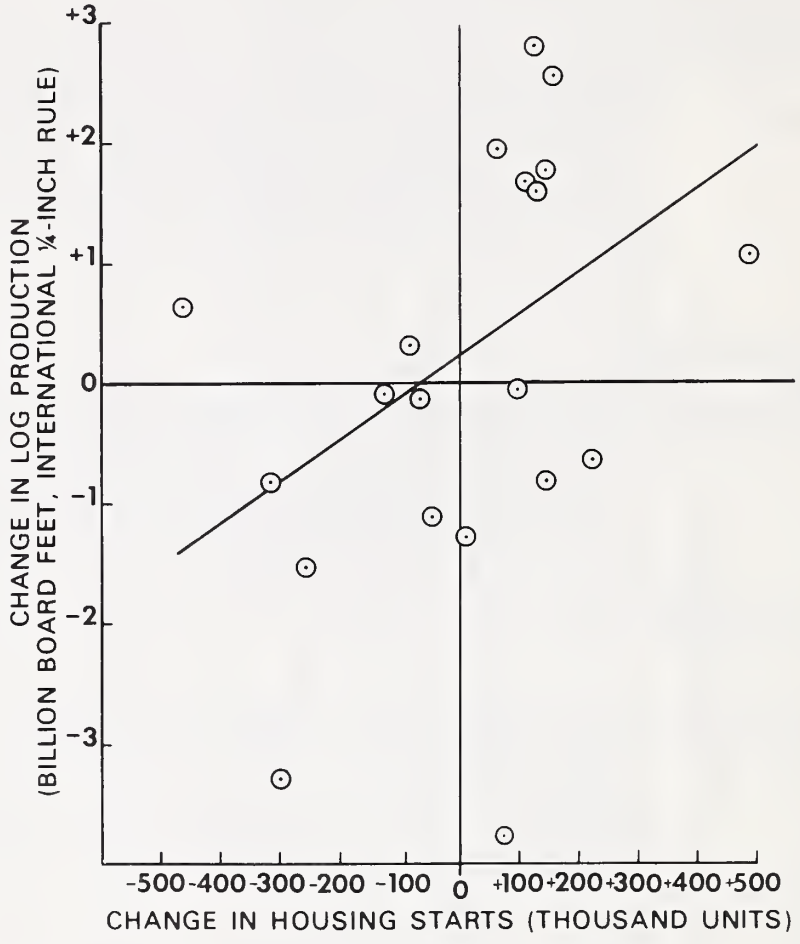

Figure 4.—Change in Washington and Oregon log production related to the change in national housing starts (nonfarm), lagged 1 year, for the 1949-69 period.

Figure 5 shows the relationship between annual changes in Oregon and Washington log production and annual changes in National Forest stumpage prices during the 1949-69 period. These data are not lagged. Lagged relationships were not significant. This linear production-price relationship is significant at the 1-percent level with an R^2 of 0.41. There was a tendency toward no

change in log production with no change in stumpage prices during the 1949-69 period. A positive increment in stumpage price of $5 per thousand board feet (Scribner) tended to be associated with a log production increase of about 800 million board feet (International 1/4-inch scale) during this period. The figure suggests that there would tend to be an 800-million-board-foot decline in total log production in a year when price was down $5 per thousand in the National Forest stumpage markets of the Pacific Northwest.

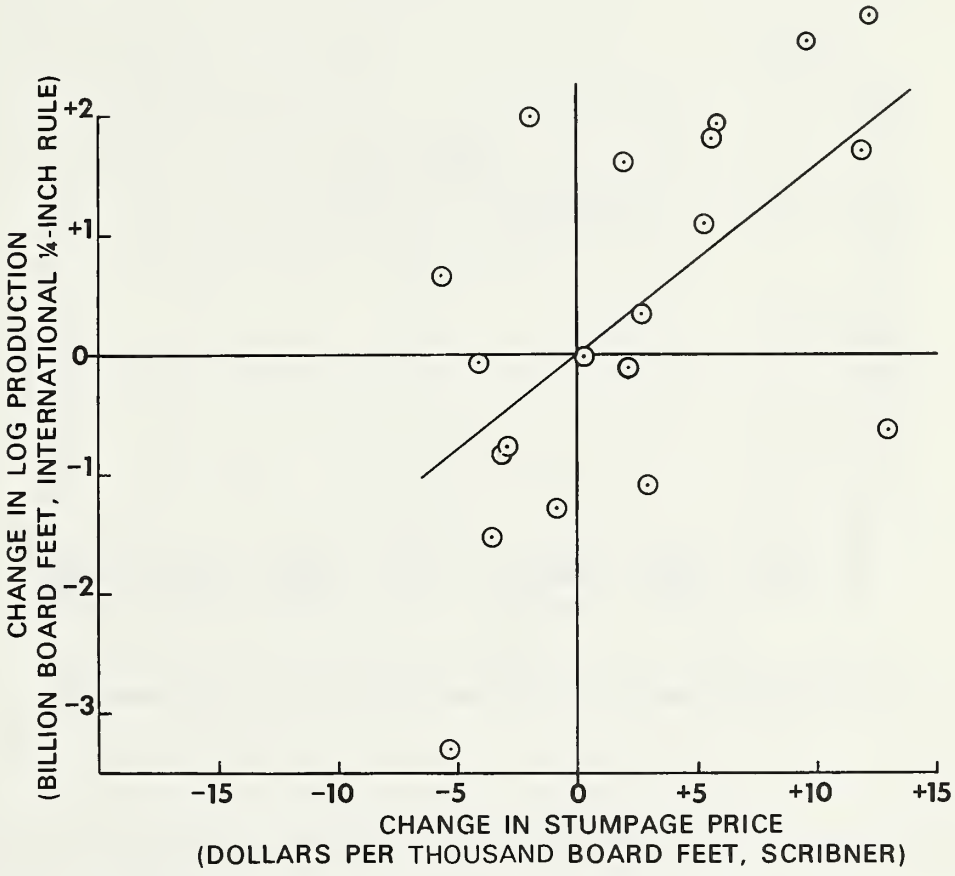

Figure 5.—Change in Oregon and Washington log production related to change in Region 6 all-species stumpage prices (1957-59 dollars) for the 1949-69 period.

Figure 6 shows the relationship between annual changes in Region 6 stumpage prices and changes in housing starts (lagged 1 year). This linear relationship is significant at the 1-percent level with an R^2 of 0.46. Curvilinear relationships were tested and were not significantly better in terms of fit. The

curve indicates that an increase of 200,000 housing units in the United States tends to be associated with a stumpage price increase in the Pacific Northwest, a year later, of a little more than $5.50. A decrease in starts of 200,000 units is associated with a price decline of about $2.50.

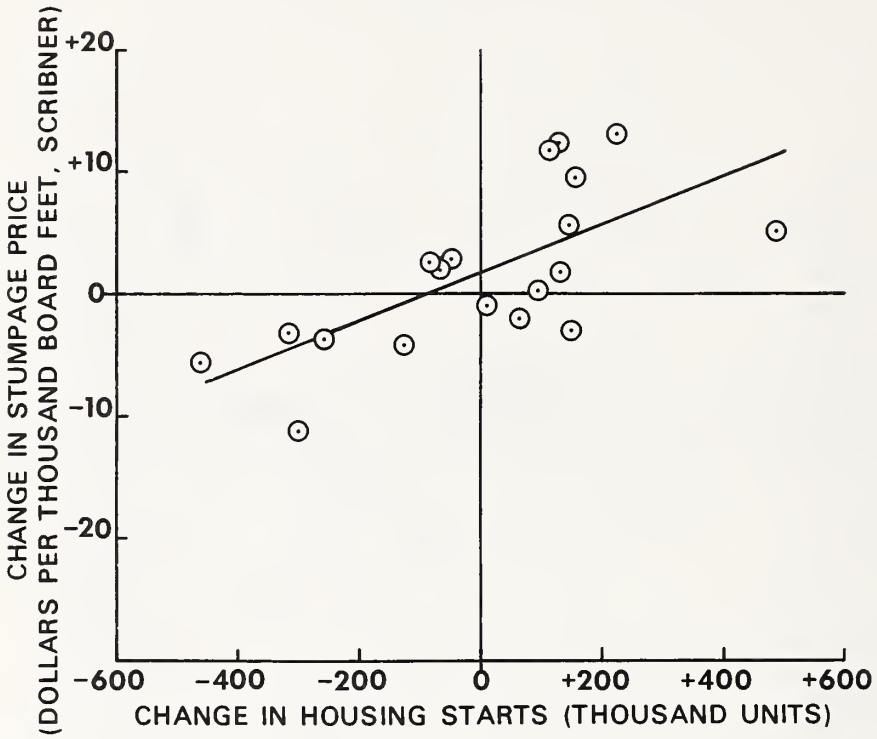

Figure 6.—Change in Region 6 all-species stumpage prices (1957-59 dollars) related to change in housing starts in the United States, lagged 1 year, for the 1949-69 period.

The curve in figure 6 does not pass through the origin; and as a result, a zero change in housing starts is associated with a slight stumpage price increase even though stumpage prices have been deflated. This suggests that even if housing starts had not changed during the 1949-69 period, stumpage prices would have risen, probably because foreign log exports from Oregon and Washington increased. Also, the demand for pulp in the Pacific Northwest rose, resulting in substantially higher wood fiber consumption. The large increases in wood consumption for pulp have been mostly in the form of sawmill coarse residues and some sawdust. As a result of improved utilization, value has been added to logs over time, and this has been reflected in rising stumpage prices. Wood such as shavings has gone into particleboard, also increasing log value. But these value increases also might be associated with the cyclical characteristics of housing starts and may not be reflected by the portion of the curve in figure 6 which lies above the zero axis.

A sequence of economic events probably links housing start changes with changes in stumpage prices as well as with changes in log production in the Pacific Northwest. As the construction of homes fluctuates in the United States, inventories of construction materials also change. For example, assume that housing starts increase for an extended period of time. At first, retailers and wholesalers would draw down their inventories, including lumber and plywood, to meet the rising demand. Eventually, these entrepreneurs would have to order more lumber and plywood as stocks run low and as they become convinced that the demand for wood will remain strong. The managers of sawmills and plywood plants acting independently will see that prices are rising and that orders are increasing. They, in turn, will probably increase mill production to fill the increased orders as their inventories of lumber and plywood begin to decline. Increased mill production will draw on log inventories. As log inventories begin to decline, the company will move to replenish the supply through harvesting and timber purchasing. In this example, one might expect both timber harvesting and stumpage prices to rise under conditions of competition and resource scarcity. However, since not all wood goes into home construction, one would not expect all the log production and stumpage price variation to be explained by these events beginning with a change in housing starts.

If there are a large number of firms in the industry, if there is freedom of entry, and if the products are similar, the conditions of competition exist in the lumber economy and the product prices are determined by the market. One would expect the demand curve as seen by the lumber firm to be fairly elastic. Mead (1966) found that these conditions do exist at the lumber production and wholesale distribution levels of the lumber economy. In the same study, he examined competition for Federal timber in local markets and concluded that this market was oligopsonistic, a situation in which there are few buyers of a factor of production.

As the hypothetical example illustrated, the demand for logs and stumpage is derived from the demand for end products. Hamilton (1970) said that one would expect that fluctuation in prices for final products would produce similar price fluctuations in the stumpage market. One characteristic of derived demand is that its elasticity is usually less than the elasticity of the demand schedule from which it is derived. He reasoned that since the demand for final products facing firms in individual timbersheds is very elastic, the demand for stumpage should also be elastic.

Hamilton tested the hypothesis that fluctuations in the general price of wood products would have a positive influence on National Forest stumpage prices. He noted that the Forest Service appraisal procedure used in setting a lower limit on stumpage prices is designed to take account of end products price fluctuations. His hypothesis was that one would expect the same relationship between bid and appraised prices as between bid and final product prices. Hamilton obtained a coefficient of correlation of 0.87 and a coefficient of determination of 0.75 in testing for a correlation between bid and appraised prices over the 1951-68 period. He concluded that final product prices have a strong influence on the prices bid for stumpage.

Given the evidence and assumptions about the nature of demand for stumpage, one would expect National Forest stumpage prices to reflect those on other ownerships. A discrepancy among stumpage values for different forest-land ownerships would tend to approach equilibrium under the assumed existence of open markets, competition, a large demand, and a limited supply of wood. In the past two decades, these conditions generally have existed in the Pacific Northwest, even though this may not be the case for specific local marketing areas. Based on the above reasoning, National Forest stumpage prices have been accepted as a proxy for stumpage values on all forest-land ownerships.

Figure 7 shows the relationship between Region 6 stumpage prices and total log production in Oregon and Washington for the 1949-69 period. Individual plotting points for each year have been identified and connected. The resulting general line patterns are formed sloping upward to the right, and this suggests that higher prices tend to be associated with larger quantities of wood produced. The observation is consistent with earlier results that both price and log production are related to advanced rising home construction.

The points shown in figure 7 each represent the intersections of supply and demand curves during the 1949-69 period. Each point represents the average supply-demand equilibrium position for a year, but over the 21-year period the equilibrium positions have been shifting. Instability of demand and supply accounts for the relationship which is formed on such a price-quantity scatter diagram. The pattern sloping upward to the right is characteristic of some industrial products where demand fluctuates widely and the conditions of supply are relatively stable.

By contrast, a curve sloping downward to the right is common in the agricultural sector (Shepherd 1968). In agriculture, often the demand for a product is fairly constant. If the supply curve shifts back and forth from year to year, it would trace out an intersection of points forming a demand curve on a single line. Such a line usually slopes downward to the right and may represent an average demand curve for some specified period of time.

In figure 7, probably the reverse of the agricultural situation is true, for the relation between production and price is positive. If supply conditions were very stable, the fluctuations in the demand for logs would trace out a rough scatter of a supply curve. However, an average supply curve for logs has not been calculated and drawn because the scatter is not tight, reflecting the fact that the conditions of supply have changed over time in the Pacific Northwest. Whereas one might argue that supply didn't change a great deal during the 1958-68 period, the graph does, however, indicate that supply probably shifted in the 1962-64 period. This was the period when National Forest allowable cuts and harvests increased and when the 1962 Columbus Day storm blowdown was harvested on a number of ownerships. Also, supply shifted upward to the left between 1968 and the end of 1969.

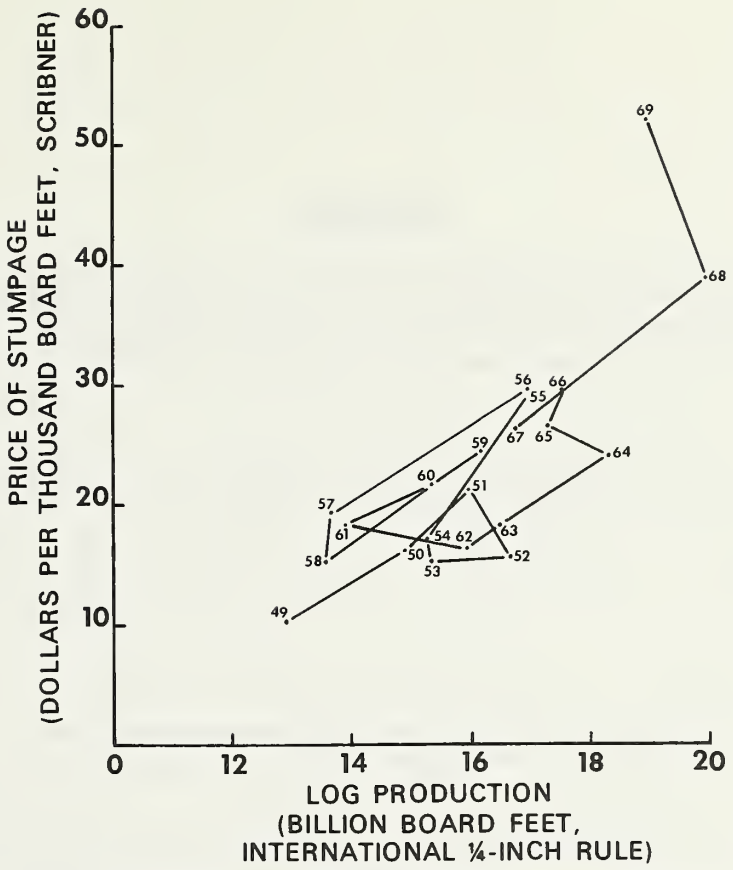

Figure 7.—Quantity of logs produced and deflated all-species stumpage prices (Region 6) in Oregon and Washington, 1949-69.

Log production fluctuations are affected by a number of factors which are not explored here. For example, labor strife or expected strikes can affect production. Expectations, weather, large changes in plant capacity, changes in allowable cuts, and changes in sales procedures could cause a change in production. These other factors which affect supply cause variation in production and tend to add variation to the relationships which were studied with respect to factors of demand. The lack of monthly and quarterly log production data precludes more detailed study to a considerable extent. However, the available log production data are an important index of the economic activity of the timber industry in the Pacific Northwest.

It does appear that the fluctuations in log production are influenced by national business conditions, especially those which affect wood products demand. Changes in housing starts partially account for log production and stumpage price fluctuations in the Pacific Northwest. This accounts for the peaking of Pacific Northwest log production and stumpage prices before general business activity in the Nation.

SUMMARY

In the history of the Pacific Northwest, log production and conversion have been major economic activities. The long-term trends in timber harvesting have been upward, and most of the harvest has come from large old-growth forest inventories. National and international demands for timber have been a major upward pressure on log production levels.

Fluctuations in Pacific Northwest log production with respect to business cycles differ after World War II compared with before. Federal Reserve monetary policy and interest rate factors contribute to the countercyclical pattern of residential construction, lumber production, and log production since World War II.

The fluctuations in log production are primarily the result of changes in the complex pattern of demand for wood products nationally. In this study it was determined that there was no significant relationship between the annual change in log production and the annual change in yields on FHA mortgages, lagged 1 year, during the 1949-69 period. However, there was an observed tendency for large mortgage yield increases to be associated with log production declines. It was found that during this period, annual changes in housing starts, lagged 1 year, were significantly related to changes in total timber harvest on all ownerships and to changes in National Forest all-species stumpage prices. Rising home construction in 1 year is related to rising log production and stumpage prices in the following year. However, statistical tests of these relationships revealed that the coefficients of determination were not very high, and thus these relationships, by themselves, would not make good predictors of the magnitude of annual log production fluctuations. The study showed that annual log production changes were significantly related to annual changes in stumpage prices. Rising log production is related to rising stumpage prices. It appears that even though timber harvests on individual ownerships have changed greatly, the total economic supply of logs from all forest-land ownerships in Oregon and Washington has been relatively stable during the 1949-69 period, but conditions of short-term supply shifts were observed.

Even though supply appears fairly stable, the variation in log production is to a considerable extent accounted for by demand variables not examined in this study. Further research using other variables and using multiple regression techniques would be needed in an effort to account for more of the log production variation. Even so, this study does indicate that changes in annual housing starts, lagged 1 year, are an important variable in accounting for annual changes in log production and stumpage prices.

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